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ABSTRACT

The instructional design process encompasses a set of interdependent phases including analysis of learners, contexts and goals; design of objectives, strategies and assessment tools; production of instructional materials; and evaluation of learner performance and overall instructional design effort. Automated instructional design (AID) tools assist instructional designers and others in creating instructional products to improve learning. In general, AID tools that support the planning and evaluation phases of ID are not as widely used by practitioners as tools that focus on the authoring and media production phases. Regardless of its strength or approach, the value of a particular tool or type of system is measured by how well it can support a particular designer's task. This ERIC Digest focuses on four types of tools that guide users through the ID process: expert systems, advisory systems, information management systems, and electronic performance systems. Authoring tools are also mentioned as popular mechanisms for supporting the production of computer-based instruction. (AEF)

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ERIC DIGEST

June 1998

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Tools for Automating Instructional Design

by Abby Kasowitz

Instructional design (ID) is the systematic process of planning events to facilitate learning. The ID process encompasses a set of interdependent phases including analysis of learners, contexts and goals; design of objectives, strategies and assessment tools; production of instructional materials; and evaluation of learner performance and overall instructional design effort (Gagne, Briggs, and Wager, 1992).

Purpose of Automated Instructional Design Tools

Automated instructional design (AID) tools assist instructional designers and others in creating instructional products to improve learning. AID systems aid in the production of courseware (Gros & Spector, 1994), or in the development of computer-based instruction (CBI), although some tools guide users in general decision-making that can apply to a range of instructional products and solutions.

AID tools may eliminate some physical ID tasks such as storyboarding and test generation (Muraida & Spector, 1993). However, the strength of AID tools lies in their ability to guide novices and non-ID professionals through the process of creating effective instruction (Tennyson & Barron, 1995; Chapman, 1995). AID tools are especially useful in situations where instructional design expertise is lacking and subject-matter experts and others are responsible for developing instruction [as seen in military courseware development (Muraida & Spector 1993)].

Types of AID Tools

This Digest focuses on four types of tools that guide users through the ID process: expert systems, advisory systems, information management systems, and electronic performance support systems. Authoring tools are also mentioned as popular mechanisms for supporting the production of computer-based instruction. Some tools contain features representing more than one type of system.

• **Expert Systems:** An expert system contains a domain-specific knowledge-base and performs decision-making and analysis functions for the designer using natural language queries (Schwier & Misanchuk, 1993). Expert systems for instructional design have been developed to provide advice to novice instructional designers (Locatis & Park, 1992) and to facilitate the development process for experienced designers.

ID Expert from the ID2 Research Group (Cline & Merrill, 1995) was created to develop and deliver computer-based instruction more efficiently. *ID Expert* is based on Instructional Transaction Theory, a "second generation" theory of instructional design (Cline & Merrill, 1995; Merrill et al, 1996; Locatis & Park, 1992). According to Instructional Transaction Theory, instruction is based on transactions (sets of interactions) between the system and the learner in order to accomplish a given task. *ID Expert* assists designers in creating transactions by presenting a set of decision-making steps involving instructional components, formatting, resources, etc. *ID Expert* is considered a prototype system and has not yet been released commercially (Merrill, 1997).

The United States Air Force Armstrong Laboratory proposed two AID approaches that use expert system technology to provide expertise to novice instructional designers and subject matter experts in the design, production, and implementation of courseware used in Air Force training (Spector & Song, 1995). *Guided Approach to Instructional Design Advising* (GAIDA) uses tutorials and context-specific advice and examples. *Experimental Advanced Instructional Design Advisor* (XAIDA) uses the Instructional Transaction Theory framework to encapsulate context-specific knowledge. Both of these environments are results of the Advanced Instructional Design Advisor (AIDA) research project (Muraida & Spector, 1993; Spector et al, 1991).

Reactions to Expert Systems: While expert systems for instructional design can teach theory validation and function as authoring tools, they are limited by their inability to support analysis and design tasks (Paquette et al, 1994). ID expert systems attempt to control the instructional design process, a process involving a large number of interrelated elements, and so must rely heavily on the knowledge and experience of the individual practitioner (Duchastel, 1990). Several instructional technologists have proposed systems that more subtly advise the instructional designer, rather than prescribe a set of solutions. Some examples are described below.

• **Advisory Systems:** Duchastel (1990) challenges the expert system model by providing an advisory system model. Instead of controlling the problem-solving process with expert knowledge, advisory systems assist or coach users in accomplishing a given task. A prototype for the advisory system approach is the *Instructional Design Advanced Workbench*, an architecture for a computer-based workbench that supports the cognitive tasks of instructional design without constraining the designer.

• **Information Management Systems:** *Instructional Design Environment* (IDE) from the Institute for Research on Learning (Russell & Pirolli, 1992) is a computer-aided design environment that supports an ID methodology for teaching the use of software in real-life problem-solving contexts. *IDE* helps document design and development options (Locatis & Park, 1992). It is intended for experienced instructional designers (Muraida & Spector, 1993).

• **Electronic Performance Support Systems:** Electronic performance support systems (EPSS) are self-instructional electronic environments that provide access to "software, guidance, advice, data, tools, and assessment with minimum support and intervention by others" (Milheim, 1997, p.103). EPSS have become popular in the 1990s for business and educational contexts that require "just-in-time" learning and a high level of a particular skill (Milheim, 1997; Leighton, 1996). Some examples of EPSS are listed below.

Building on Duschastel's "workbench," Paquette et al (1994) introduced a performance support system called *AGD* (a French acronym meaning Didactic Engineering Workbench). *AGD* provides procedural instructional design information to guide users in defining the learning system (e.g., analyzing training needs, designing peda-

gogical structures). *AGD* includes a rules-based advisory component that offers advice regarding specific design decisions made by users (e.g., amount and nature of objectives).

Other performance support systems tools include *Designer's Edge* from Allen Communication (Chapman, 1995) and *Instructional DesignWare* from Langevin Learning Services (Langevin Learning Services). Like *AGD*, these tools support the planning phases of instructional design, but contain a much more general advisory component (e.g., context-specific online help, wizards, and tutorials).

In contrast to *AGD*, *Designer's Edge* and *Instructional DesignWare* lead designers through all tasks involved in instructional design, but place more emphasis on the ultimate production phase. Both tools provide a graphical representation of the instructional systems design model, thus leading to additional support for completing each step of the model. Data entered by users are cross-referenced with all steps to enhance continuity between phases. Usable reports and documents such as evaluation instruments, content outlines, lesson plans, and checklists can be generated by the users.

The primary difference between the two products lies in their intended audiences and purposes. *Designer's Edge* is for both novice and experienced instructional designers planning computer-based instruction. The product includes support for scripts, storyboards and other CBI production needs. Integration with external software applications is also supported (Allen Communication, 1997). *Instructional DesignWare* is intended for course designers and trainers interested in producing either computer-based or classroom training. For this reason, more support is provided for decisions regarding media selection and course and presentation materials (Langevin Learning Services).

Authoring Tools

Although they do not necessarily support the preliminary planning stages of instructional design, instructional designers use authoring tools in the development phase to produce computer-based instruction (Paquette et al, 1994; Locatis & Park, 1992; Merrill, 1997). Some authoring tools take advantage of the World Wide Web by providing features that integrate Web content into computer-based instruction and deliver instruction over the Web (e.g., WebCT).

According to Merrill (1997), authoring tools simplify the programming process and allow experienced users to create effective and visually-appealing instruction, but require a steep learning curve in order to take full advantage of their features. Current popular authoring tools include Macromedia *Authorware 4.0*, Aim Tech *IconAuthor*, WBT Systems *TopClass*, and Asymetrix *Toolbook*.

Summary

Some AID tools support instructional design by focusing on the cognitive aspects of instructional design (e.g., *ID Expert*, *AGD*, etc.). Some highlight the procedural steps of ID (e.g., *Designer's Edge*, *Instructional DesignWare*). Others support the production phase only (i.e., authoring tools for computer-based instruction).

In general, AID tools that support the planning and evaluation phases of ID are not as widely used by practitioners as tools that focus on the authoring and media production phases (Chapman, 1995). One exception may be *Designer's Edge* which has been cited as one of the most popular CBT authoring tools despite its intended purpose as a pre-authoring system (Kemske, 1997). Regardless of its strength or approach, the value of a particular tool or type of system is measured by how well it can support a particular designer's task (Gros & Spector, 1994).

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